Hypercerts: A new primitive for impact funding systems
(draft v0)

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1. Introduction

The world faces unprecedented challenges, from climate change to safe artificial intelligence, that require billions to trillions of dollars of public goods funding. High-upside/high-uncertainty endeavors are often overlooked due to the absence of strong incentives to pursue them in the dominant public goods funding framework of at-cost grants or even a milestone-bounty framework (which directly exposes small contributors to aversive risk levels). Yet these should be pursued when the expected positive value[1] is very high, as it often is. New impact funding mechanisms can address this. One such mechanism is retrospective funding, which rewards projects based on the impact they create after the impact is observable. If projects can reasonably expect such retrospective rewards, they are incentivized to maximize their impact and – together with prospective funders – take risky bets when the expected positive value is high.

In order for Impact Funding Systems (IFSs) to be most effective, they should be interoperable regarding (1) funding mechanisms, (2) funding sources, and (3) evaluations. Quadratic voting, bargaining solutions, DAO-style votes, milestone bounties, and simple unconditional grants all have their strengths, among others. We do not wish to lock in any particular decision-making scheme for funders. Without mechanisms like these, multi-funder coordination on impact funding is prohibitively expensive, leading to suboptimal efficiency in impact capital allocation. Funders should be able to easily collaborate with other funders or to intentionally fund different projects to diversify the funded approaches. Evaluators should be able to evaluate the same impact with different methodologies – potentially with conflicting results, to foster rigor and progress of evaluation methodologies.

[1] The positive value created is what we will refer to as impact. Attributing impact to work is non-trivial, we will return to this in a later section. Quantifying value, often achieved using markets, is also nontrivial, especially for non-excludable goods, such as public goods or commons.

Hypercerts create this interoperability by serving as a single, open, shared, decentralized database for impact funding mechanisms. A single hypercert is a semi-fungible token that accounts for work that is supposed to be impactful and whose ownership is fractionizable and transferable (under specific conditions). Hypercerts do not impose any specific funding mechanisms but provide baseline invariant guarantees such that claims will not be forgotten as different mechanisms come into and out of fashion. This is also why hypercerts are especially useful for any retrospective funding mechanisms – funding can be applied to claims of the past.

The next chapter introduces IFSs and how hypercerts improve their effectiveness. Chapter 3 defines hypercerts conceptually. Chapter 4 adds the concept of an open evaluation system that contrasts hypercerts with simple impact certificates. Chapter 5 discusses the technical implementation of hypercerts. Chapter 6 shows how hypercerts can support retrospective funding to create powerful incentives for more impact.

2. Impact Funding Systems (IFSs)

Defining IFSs

An IFS consists of

1. **Actors**: Contributors, funders, evaluators, and beneficiaries (see table 1)
2. **Funding mechanisms**: Grants, bounties, retrospective funding, etc.
3. **Coordination mechanisms**: Roadmapping, communication forums, etc.
4. A **goal**: Maximize the domain-specific positive value created (impact)

The goal will be specific to the impact area, e.g. prevent existential risks from artificial intelligence (AI) would be the goal for the impact area "AI safety."[2] To achieve these goals, skilled contributors must work with high effort on promising projects. Additionally, for those projects that create impact continuously, sufficient income streams are necessary to cover both their ongoing

[2] These goals also define the boundaries of an IFS. Multiple IFSs can overlap.

Type	**Subtype**	**Description**
1. Contributors		People or organizations who do the work
2. Funders	Prospective funders	People or organizations who fund work before it is done
	Retrospective funders	People or organizations who fund work after it is done
3. Evaluators	Scouts	People or organizations who evaluate the potential impact of work before it is done
	Auditors	People or organizations who evaluate the impact of work after it is done
4. Beneficiaries		People or objects that are impacted by the work

Table 1: Actors in an IFS. It isn't unusual that two actor types overlap, e.g. retrospective funders perform the evaluations themselves or beneficiaries are at the same time retrospective funders or auditors.

operating expenses and contributors' upside incentives. Hence, an IFS needs to answer the following four questions:

1. **Projects:** How can we improve the chances that the most promising projects are worked on?
2. **Talent & resources:** How can we attract top talent to contribute to the most promising projects and provide them with the necessary resources?
3. **Effort:** How can we reward contributors for their impact on outcomes?
4. **Sustainable income:** How can we create recurring income streams and financial sustainability for impactful projects?

Markets have been proven very powerful in answering these questions if they are directed towards maximizing profits. As we are directing systems towards maximizing impact, these answers become more challenging. In particular, in an IFS we are facing coordination and incentive problems in funding impact, such as the free-rider problem.

Hypercerts as a data layer

In order for IFSs to be most effective, they should be interoperable regarding (1) funding mechanisms, (2) funding sources and (3) evaluations. Figure 1 shows a potential dynamic between the actors of an IFS. In that scenario hypercerts can account for the prospective funding (steps 2-3) as well as for the retrospective funding (steps 8-9) from different funders. Evaluations are made public and can be discovered through the hypercerts for all funders (steps 5-7). Retrospective funders can reward not only the contributors but also the prospective funders (steps 10-11).[3]

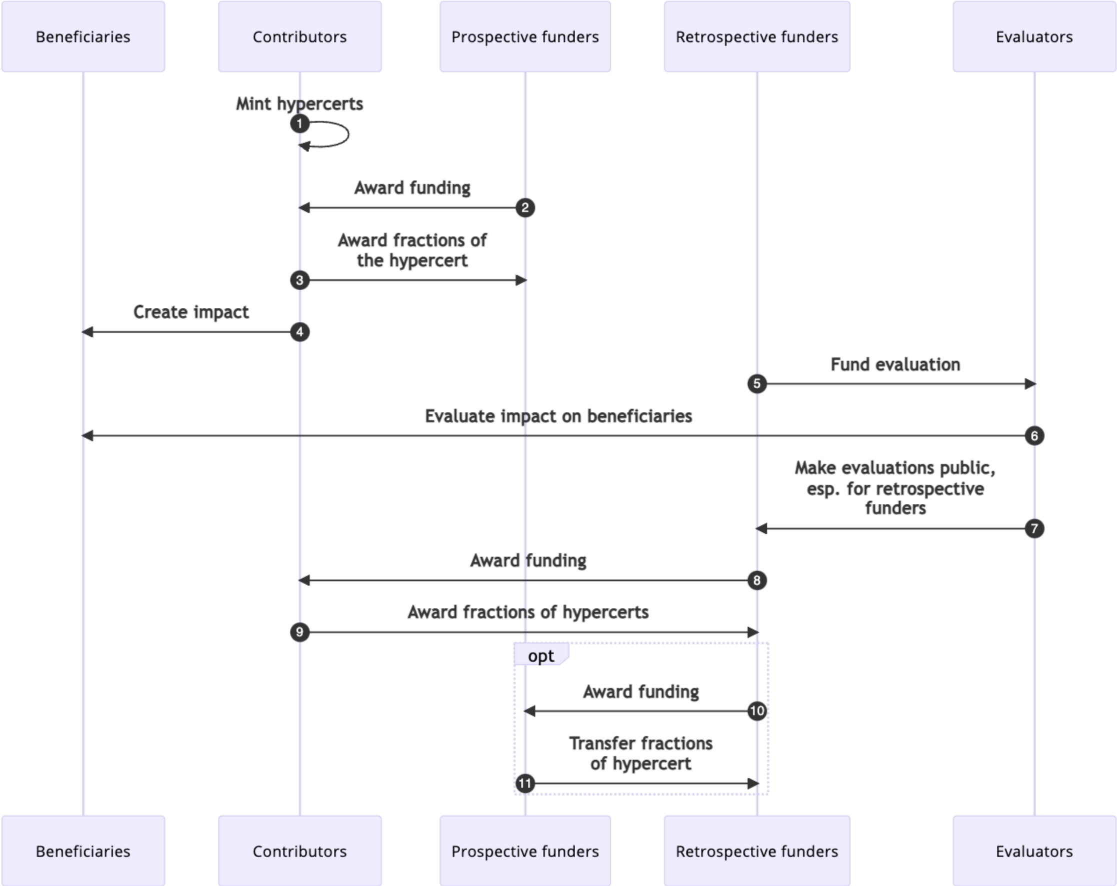

Figure 1: Potential dynamics between actors in an IFS with hypercerts (opt = optional)

[3] This step depends on the transferability of hypercerts, but it isn't necessary for hypercerts to be useful.

By serving as a single, open, shared, decentralized database hypercerts lower the transaction costs to coordinate and fund impactful work together. This is important because the optimal funding decisions of a single funder depends on the funding decision of all other funders. For instance, some work is only impactful if a minimum funding is provided: The impact is non-linear in the funding amount, e.g. half a bridge is not half as impactful as a full bridge. Other work might be over-funded, i.e. the impact of an additional dollar is basically zero. Ultimately, funders want to find the highest impact for each additional dollar spend (cf. S-process as in Critch, 2021). Today multi-funder coordination on impact funding is prohibitively expensive, leading to suboptimal efficiency in impact capital allocation. Through hypercerts the funding becomes more transparent and the credits for funding impactful work can be easily shared. Coordinating funding becomes easier.

Hypercerts don't solve this coordination problem by themselves, but build the basis for different decision and funding mechanisms as shown in figure 2. Quadratic voting, bargaining solutions, DAO-style votes, milestone bounties, and simple unconditional grants all have their strengths, among others. Hypercerts do not lock in any particular decision-making scheme for funders.

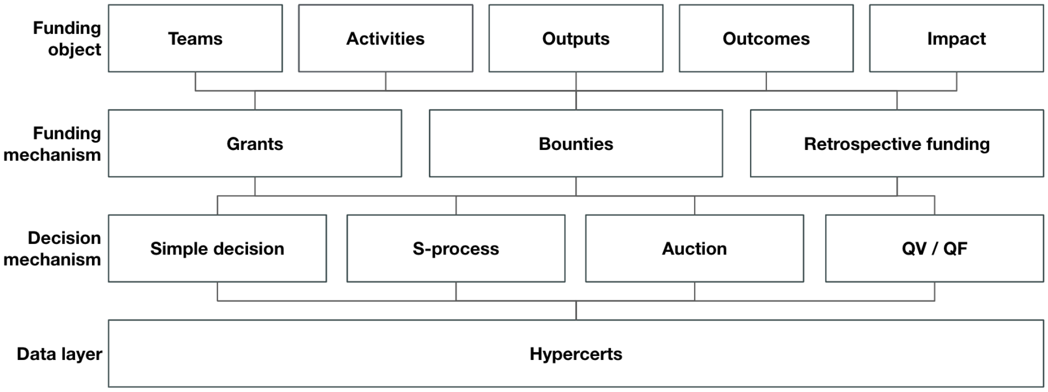

Figure 2: Hypercerts as a data layer for an IFS. Funding and decision mechanisms are not exhaustive.

Looking farther into the future: If a large majority of funding across an entire IFS ends up flowing through hypercerts, funders have created the transparency that enables each of them to make the best decisions given the funding decision of everyone else.

3. Hypercerts

Defining hypercerts

A hypercert accounts for the work that is supposed to be impactful. A graphic as part of the semi-fungible token visualizes each hypercerts (figure 3).

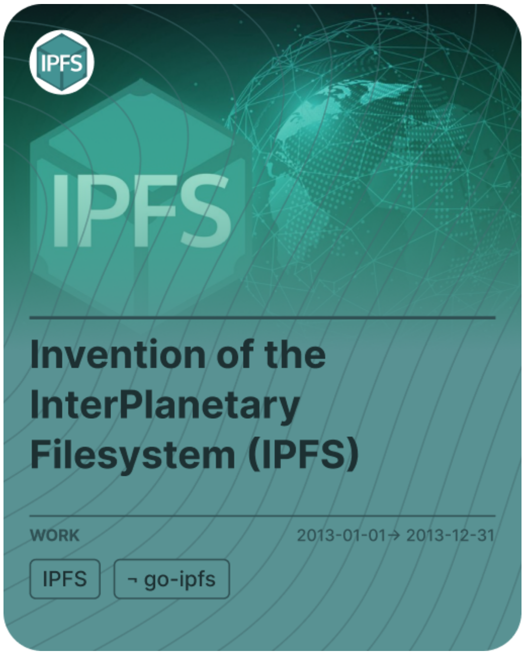

Figure 3: Example graphic of a hypercert

Hypercerts serve three functions:

- **Identifiability:** Hypercerts clearly define the work that is supposed to be impactful by creating a record of who (set of contributors) claims to do or have done what (scope of work) in what time period (time of work). They also allow the creation of multiple records of the same work to identify separate impacts that this work had or will have (scope of impact) over specified time periods (time of impact).

- **Traceability:** As these records are public and logically monotonic[4] (immutable, except to split or merge hypercerts), records are durable and permanent.
- **Transferability:** The records are a digital object that can be owned and ownership can be transferred (under specific conditions). As hypercerts can be created as fractionalizable, it is also possible to transfer only a specified fraction of the hypercert. Each hypercert defines the rights over the defined work that owners have, such as rights to retrospective rewards, rights to public display of the support ("bragging rights") or rights to passive income from intellectual property.

Importantly a hypercert does not specify the "size" of the impact, e.g. a hypercert does not state *"5 tons of CO2 removed from the atmosphere."* Instead the hypercert only defines the work, e.g. *"200 trees protected"* (scope of work) in 2022 (time of work). The size of the impact is then left to the evaluations of the "CO2 in the atmosphere" (scope of impact) in 2022 (time of impact) that point towards the covered region of the hypercert. For instance: This allows a self evaluation to claim that 5 tons of CO2 were removed in a given year as well as one or multiple evaluations from independent auditors to confirm or challenge how much CO2 has been removed. An evaluator could detect that some of the trees were not healthy and hence only 4 tons of CO2 were removed. Allowing for multiple evaluation is a defining characteristic of the open evaluation system.

[4] See Regents of the University of California (2011)

Definition: A hypercert is a semi-fungible token that accounts for work that is supposed to be impactful and represents all or parts of that impact. A hypercert has the following fields (one for each dimension):

1. **Set of contributors**
   An ordered[5] list of all contributors, who claim to do or have done the work described by this hypercert.[6]

2. **Scope of work**
   A conjunction of potentially-negated work scope tags, where an empty string means “all”:
   <scope-of-work> ::= <scope-atom> AND <scope-of-work> | ” ”
   <scope-atom> ::= <scope-tag> | NOT <scope-tag>

3. **Time of work**
   A date range, from the start to the end of the work being claimed by this hypercert.[7]

4. **Scope of impact**
   A conjunction of potentially-negated impact scope tags, where an empty string means “all”:
   <scope-of-impact> ::= <scope-atom> AND <scope-of-impact> | ” ”
   <scope-atom> ::= <scope-tag> | NOT <scope-tag>

5. **Time of impact**
   Date ranges from the start to the end of the impact.

6. **Rights of the owners**
   An unordered list of usage rights tags, which define the rights of the owners of this hypercert over the work being claimed by this hypercert.

Box 1: Definition of a hypercert

[5] The order is irrelevant for the functionality of the hypercert, but can be used to define the order when lists are displayed, for instance on the graphic representation of a hypercert. The same applies to the ordering of the scope of work and scope of impact.

[6] Contributors are generally itemized as wallet addresses or ENS names, but can also be names / pseudonyms. Groups of contributors can be represented by a multisig or name of an organization.

[7] The start date is implicitly attributed 00:00:00 UTC and the end date is implicitly attributed 23:59:59 UTC.

In the simplest cases of hypercerts, the scope of work and impact as well as the time of impact are not restricted and no rights are transferred to owners of the hypercerts, i.e. the hypercerts just define the who (set of contributors) and when (time of work) of the claimed work. Scope of work and impact would be set to *all*, time of impact to "indefinite" and the rights to only "public display of support". The latter is always included as the hypercert is a public record, such that owners will always automatically display their support of the work.

Take for example hypercert 1 in table 2: It represents all work that contributor 1 has performed in 2013 with all the impact that the work had from the beginning of the work; the hypercert doesn't give any additional rights to the owners of the hypercert.

The other fields – except the rights field – can be used to limit the work or impact that is represented by the hypercert. Hypercert 2 limits this to the work on IPFS in 2013, i.e. any other work besides IPFS that contributor 1 performed is not included. Hypercert 3 limits it even further as it excludes a specific aspect of IPFS, the go-ipfs implementation.

	Hypercert 1	**Hypercert 2**	**Hypercert 3**
Set of contributors	Contributor 1	Contributor 1	Contributor 1
Scope of work	*all*	*IPFS*	*IPFS ∧ ¬ go-ipfs*
Time of work	2013-01-01 to 2013-12-31	2013-01-01 to 2013-12-31	2013-01-01 to 2013-12-31
Scope of impact	all	all	all
Time of impact	2013-01-01 → indefinite	2013-01-01 → indefinite	2013-01-01 → 2013-12-31
Rights	Public display of support	Public display of support	Public display of support

Table 2: Examples of different scopes of work

Table 3 illustrates a use case for limiting the scope of impact. Suppose contributor 1 protects trees in a certain area. This work has positive effects on the CO2 in the atmosphere and could turn into carbon credits; however, the trees have additional positive impacts, such as protecting biodiversity. Instead of including all positive impacts in one hypercert (hypercert 4 in table 3), the impact can be split between the impact on CO2 in the atmosphere (hypercert 5) and all other positive impacts (hypercert 6). If funders are willing to pay for biodiversity, this would be a new income opportunity. And it would account for the additional positive impact that other methods of reducing CO2 might not have, like industrial carbon capture. Importantly, negative impacts can not be excluded from a hypercert.

	Hypercert 4	**Hypercert 5**	**Hypercert 6**
Set of contributors	Contributor 1	Contributor 1	Contributor 1
Scope of work	*Protecting trees in area X*	*Protecting trees in area X*	*Protecting trees in area X*
Time of work	2013-01-01 to 2013-12-31	2013-01-01 to 2013-12-31	2013-01-01 to 2013-12-31
Scope of impact	*all*	*CO2 in atmosphere*	*all* ∧ ¬ *CO2 in atmosphere*
Time of impact	2013-01-01 → indefinite	2013-01-01 → indefinite	2013-01-01 → indefinite
Rights	Public display of support	Public display of support	Public display of support

Table 3: Examples of different scopes of impact

Implementing hypercerts as a semi-fungible token allows multiple contributors and funders to own parts of hypercerts. For instance the original contributors can award 10% of a hypercert to a funder, while keeping 90%, which they can award to other funders later. This is why hypercerts are fractionalizable.

Merging and splitting hypercerts

Besides the fungible dimension, hypercerts can be merged and split on any of the six dimensions as shown in box 1. Let us take the hypercert 1 from table 2 from above and focus only on two of the dimensions, scope of work and time of work. These two dimensions create a simplified *impact space*. Figure 4 shows how work on IPFS (InterPlanetary File System) could have been minted over time in separate hypercerts, one for each quarter of work.[8]

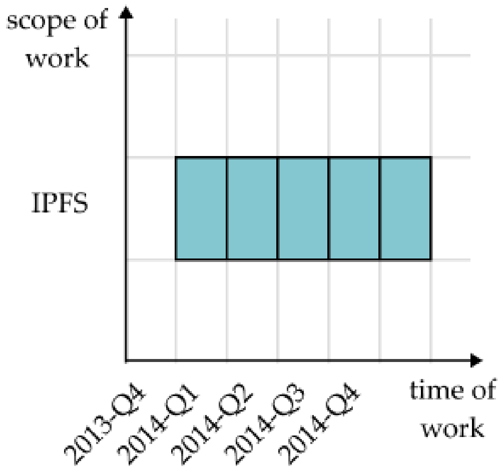

Figure 4: Minting hypercerts on a two-dimensions of the impact space

In figure 4 we created five hypercerts, one for each quarter of work. As the resulting work of all of these together is IPFS 0.1, the merged hypercert in total is more meaningful and more valuable than just the five individual hypercerts. In this case the proverb is true, the whole is greater than the sum of its parts. Hence, we want to merge them as shown in figure 5.

[8] See Dalrymple (2022) for a talk introducing hypercerts and this example.

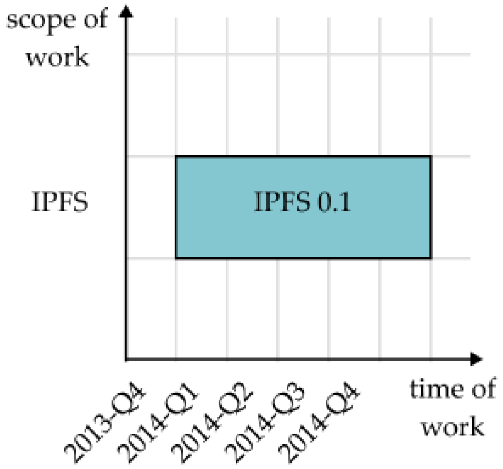

Figure 5: Merging hypercerts on a two-dimensions of the impact space

Conversely, splitting can increase the meaningfulness and value of hypercerts as well. We can split the work on IPFS 0.1 into the conceptual work "invention of IPFS" and the implementation via "go-ipfs 0.1" as shown in figure 6.

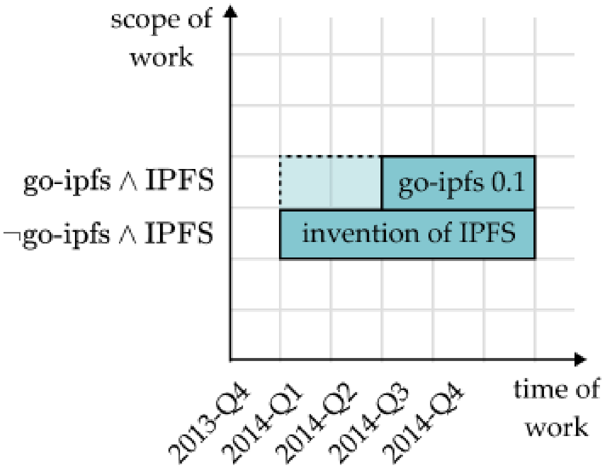

Figure 6: Splitting hypercerts on a two-dimensions of the impact space

Other use cases are where multiple contributors want to combine their work on the same scope of work (**merging**) or disentangle their work (**splitting**).

Ultimately, splitting and merging allows users to repackage the digital representation of their work and impact.

Importantly, splitting and merging are the only operations that are permitted to change hypercerts. Once an area in the impact space is claimed, it can not be unclaimed. This ensures that claims are never forgotten.

Retiring hypercerts

While a claim in the impact space can not be unclaimed, it can be **retired**. Retiring a hypercert means that owners can not transfer and sell it anymore. This way owners prove that they are the final buyers of the impact. Technically retiring hypercerts means that they are sent to a specific null address, which ensures that the retired hypercerts are recorded and traceable.

Consistency of the impact space

Every hypercert represents a claim in the *impact space*, which itself represents all possible claims. Above we illustrated the impact space with two dimensions, scope and time of work. The complete impact space is spanned by the six dimensions introduced in the definition of hypercerts.

Every point in the impact space should either be claimed or not be claimed. No point must be claimed twice, or equivalently:

- If the impact of some work is represented in one hypercert, it must not be part of any other hypercert.
- Hypercerts must not overlap with each other.

Table 4 shows two hypercerts that were illustrated in figure 4, but now with all six fields. The two hypercerts can represent the exact same work by the same contributor, but they do not overlap because of the difference in the time of work.

	Hypercert 7	**Hypercert 8**
Set of contributors	Contributor 1	Contributor 1
Scope of work	IPFS	IPFS
Time of work	*2013-10-01 to 2013-12-31*	*2014-01-01 to 2014-03-31*
Scope of impact	all	all
Time of impact	2013-10-01 → indefinite	2014-01-01 → indefinite
Rights	None	None

Table 4: Example of non-overlapping hypercerts

The consistency of the impact space is crucial as it ensures that no rights to an impact claim are sold twice. If for example someone owns the right to retrospective rewards for the impact of some work, the owners must be identifiable unambiguously.

Because users can create hypercerts with arbitrary data on any chain, on which a hypercert contract is deployed, we provide ways to help users detect collisions in the impact space. For example, if one hypercert on Ethereum points to the work on "IPFS", and another hypercert on Filecoin points to the work on "https://github.com/ipfs/go-ipfs" both with the same contributor and time of work, which of these overlapping hypercerts is the correct one to support? To surface such overlapping hypercerts, the hypercerts protocol and SDK will support mechanisms to index, search, and visualize neighbors in the impact space. With these tools evaluators[9] can quickly detect potential conflicts and submit the results as evaluations to help disambiguate proper credit and attribution.

[9] At some point it might be possible to fully automate these evaluations as smart contracts.

Emerging ontologies

Common ontologies for the scope of work and scope of impact are useful to create transparency and improve discoverability. Such ontologies need to be created from the practices and should be adapted over time. They are like emerging norms, instead of fixed rules. However, some larger players or a group of smaller players could enforce certain ontologies, e.g. if multiple funders agree that they only fund projects that follow a specified ontology.

As some ontologies might be more useful than others, we would ideally see a consensus emerge between participants and experts in each impact area. Decentralized governance institutions can help facilitate this; however, further details on the design are out of the scope of this paper and are left for future work.

4. Open evaluation system

A key design element is that hypercerts themselves do not make a claim about the size of the impact, but only account for the work that is supposed to be impactful. Figure 7 shows this contrast in a simplified illustration of the example that we introduced above. The open evaluation system allows multiple evaluations to point at the same area of the impact space that a hypercert claims. The evaluations can include self-evaluation from the contributors themselves. Funders observe these and make their funding decisions based on this richer set of information.

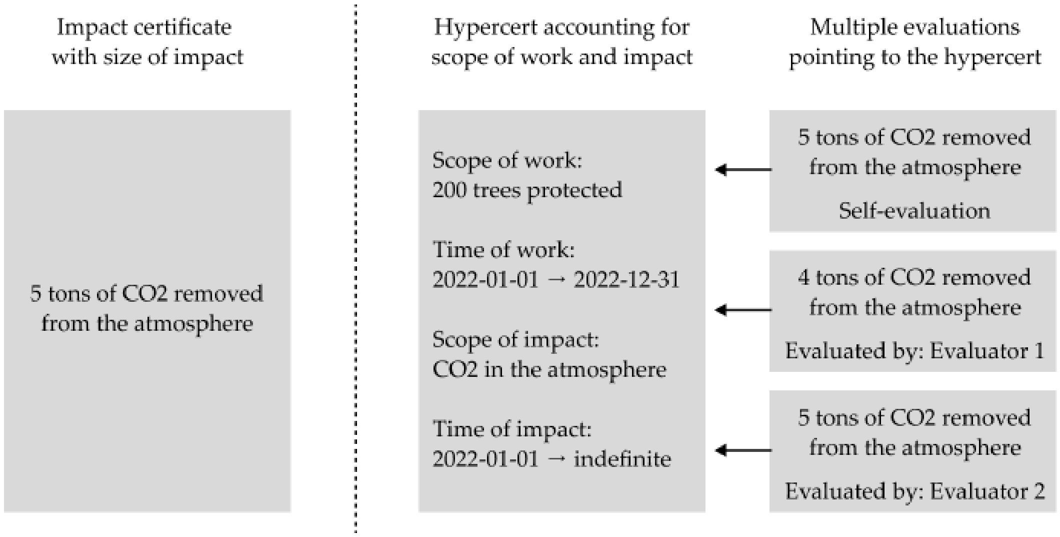
Impact certificate with size of impact
Hypercert accounting for scope of work and impact
Multiple evaluations pointing to the hypercert
5 tons of CO2 removed from the atmosphere
Scope of work: 200 trees protected
Time of work: 2022-01-01 → 2022-12-31
Scope of impact: CO2 in the atmosphere
Time of impact: 2022-01-01 → indefinite
5 tons of CO2 removed from the atmosphere
Self-evaluation
4 tons of CO2 removed from the atmosphere
Evaluated by: Evaluator 1
5 tons of CO2 removed from the atmosphere
Evaluated by: Evaluator 2

Figure 7: Simplified illustration of simple impact certificates vs. hypercerts with an open evaluation system

The open evaluation system is also used to provide additional information, e.g. an evaluator or the project itself provides information about the health of the trees. This information can then be used transparently by other evaluators to evaluate the impact on CO2 in the atmosphere.

An important feature is that the evaluations do not directly point at a hypercert, but rather at an area in the impact space. In practice this area will mostly be the exact same area that a hypercert claims, such that it can be considered an evaluation of the hypercert, but it does not have to. This feature ensures that, if hypercerts are merged or split, previous evaluations will continue to be linked appropriately.

The form of evaluations can be standardized to simplify handling and comparing multiple evaluations from multiple evaluators. The open evaluation system allows for templates to be created and used by any evaluators. Similar to the emerging ontologies, these are not enforced centrally, but should emerge as useful standards – potentially steered by decentralized governance institutions.

Important characteristics of the open evaluation system are:

- Evaluators can submit multiple evaluations of the same area in the impact space as more information becomes available
- Evaluations can challenge other evaluations
- Evaluation methodologies can evolve over time

These features allow the whole evaluation system to be dynamically improved by each actor. The relevant incentives for this improvement will stem from the funders who will value the signals from some evaluators more than others and evaluators are able to build up reputation.

5. Technical implementation

Hypercerts as a semi-fungible token

In order to make the token identifiable, traceable, and transferable, hypercerts are represented as ERC-1155 tokens. The ERC-1155 standard enables a single deployed contract to store many hypercerts, facilitating simpler creation, transfers, as well as splitting and merging of hypercerts within a single namespace. As a semi-fungible token, each unique token represents a fraction of ownership of a hypercert. Hypercerts are then represented as a group of tokens, where the total ownership sums to 100%. In order to easily identify which hypercert a token belongs to, we utilize the upper 128 bits of a 256-bit token ID to identify the hypercert (see figure 8). All tokens within the same hypercert group should share the same ERC-1155 Metadata.

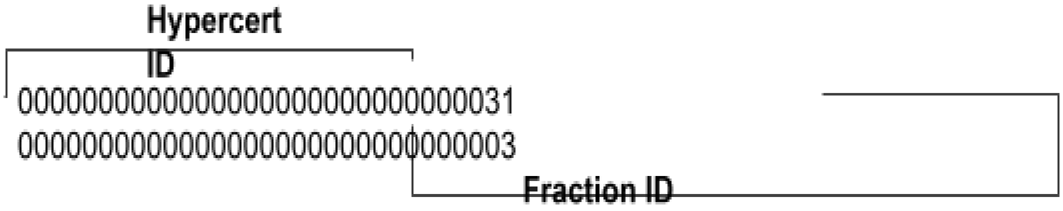

Figure 8: Token ID broken into a hypercert ID and a fraction ID

For illustrative purposes, let us assume that token IDs are just 2 bytes long, where the first byte represents the hypercert ID and the last byte represents which fraction of ownership. Alice could create a new hypercert token 0x2301, representing 100% of hypercert 0x23. If Alice wanted to transfer 20% to Bob, Alice could perform a split operation by minting token 0x2302 and transferring 20% of value to it, such that tokens 0x2301 and 0x2302 represent 80% and 20% ownership respectively of hypercert 0x23. Then Alice transfers token 0x2302 to Bob. Similarly, they could merge these 2 tokens together, back to form a token that represented 100% ownership. In this case, the value of 0x2301 would be transferred to 0x2302, and then 0x2301 is subsequently burned.

Alice can also choose to split or merge hypercerts along some dimension of the impact space. For example, Alice may split hypercert 0x23 into two new hypercerts — 0x24 representing work done before the year 2000, and 0x25 representing work done after 2000. The original hypercert 0x23 is burned and the two new hypercerts store a reference to the previous hypercert.[10] When the history of splits and merges are indexed, we can easily trace through the provenance of any individual hypercert.

Claim Data

Hypercert claim data, such as scope of work and the contributor list, is encoded in JSON format into the ERC-1155 Metadata. Claim data can be stored on-chain along-side the token, or in off-chain storage such as IPFS. For details on the JSON schema and how off-chain storage can be utilized, see the hypercerts-sdk repository.

[10] Alice can also split a hypercert if she own only a fraction of it. Suppose she owns 50% of 0x23 and Bob own 50% of 0x23. Alice splits her fraction into 0x24 and 0x25 as before, but since she only owned 50% of the original 0x23, she also only owns 50% of 0x24 and 50% of 0x25. Bob's 50% of 0x23 is not affected. Regarding the merge operation, it is only possible to merge hypercerts that represent the exact same fraction, e.g. Alice can not merge 50% of 0x24 and 30% of 0x25, but she can merge 50% of 0x24 and 50% of 0x25.

When considering whether to store hypercert metadata on-chain or off-chain, we can consider the different trade-offs to the user experience and cost, which may differ depending on which blockchain is being used. Storing data off-chain saves on costs, but could lead to on-chain claims without the metadata. Storing data on-chain adds additional security that the claims will not be forgotten but can lead to higher gas fees.

Beyond the standard fields of hypercerts that locate the hypercert in the impact space, additional fields can be added. This allows for different templates in different impact areas, such as AI safety or biodiversity, as different additional information will be useful. Importantly, however, all hypercerts will be located in a single impact space – the additional fields do not change that.

Multi-chain support

We expect hypercerts to exist in a multi-chain ecosystem, where the local deployment can be used to support the unique funding systems of that community. In order to visualize a single global impact space, we index the different contract deployments across chains and surface any potential hypercert claim conflicts. Because different blockchains support different subsets of programming languages, we do expect different implementations of the hypercert protocol to exist. However, they must adhere to the same hypercert data model to be indexed into the impact space.

In order to decide which deployments to index into the hypercerts impact space, decentralized governance institutions will be used to govern the list of contract addresses used across all blockchains.

Transferability restrictions

Hypercerts are generally transferable. However, there are use cases, in which minters of hypercerts want to restrict how their hypercerts can be transferred. The protocol allows the minter to restrict who can transfer the hypercert and/or to whom the hypercert can be transferred. For instance, by specifying that only the original owner can transfer the hypercert, any future owner is prohibited from selling it, i.e. a secondary market would not exist for this hypercert.

6. Retrospective funding

Introducing retrospective funding

While hypercerts do not impose any specific funding mechanisms, they are especially useful for retrospective funding. The core idea, from the perspective of contributors building impactful goods, is this: if you can reasonably expect to get funded retrospectively for your work once you produce a positive impact, then you can work now, in expectation of a probabilistic future cash flow.[11] In another conception, you are effectively "borrowing" money from this anticipated future cash flow to fund the work in the first place; the expectation of future funding "retro-causes" the impactful work. Retrospective funding may be able to 1) provide incentives for contributors to take on impactful goods projects with a potentially high, but uncertain, impact and 2) create a more efficient IFS by back-propagating signals on what outcomes were impactful post-hoc.[12]

In addition, contributors are able to receive fair compensation by providing outsized impact that will be highly valued. It incentivizes you to create a positive impact, beyond your intrinsic motivation.[13] This does not mean that the most successful contributors to impactful goods automatically have potential upside comparable to some for-profit startup founders (or that they should), just that their potential upside does depend on how much funders later value their past

[11] Prize competitions, social impact bonds and carbon credits are forms of retrospective funding. The first two have not yet scaled and shown their full potential. Hypercerts as an infrastructure layer aims to contribute to the scalability of these approaches.

[12] Part of this section was first published as a blogpost, see Brammer (2022).

[13] In the design of these financial incentives, we have to be careful about crowding-out effects of intrinsic motivation. Incentives do not just add up, but they depend on the specific context and conditions.

work. This will attract more talent to the impact sector by improving performance-based compensation.

The crucial aspect for this to work: funders need to retrospectively fund impact, and send credible signals that they will do so in the future. Based on these signals contributors form expectations about future retrospective rewards and can start working today to receive them in the future.

Hypercerts facilitate retrospective funding as the impact claims are identifiable, traceable and transferable. Contributors can sell parts of their hypercerts to prospective funders to receive the necessary funding for their project ("activity" in figure 9). The project delivers impact to a larger group ("beneficiaries"), which retrospectively buys the hypercerts from the prospective funder, and from the contributors if they retained some fraction of their hypercerts (the latter is not represented in figure 9).

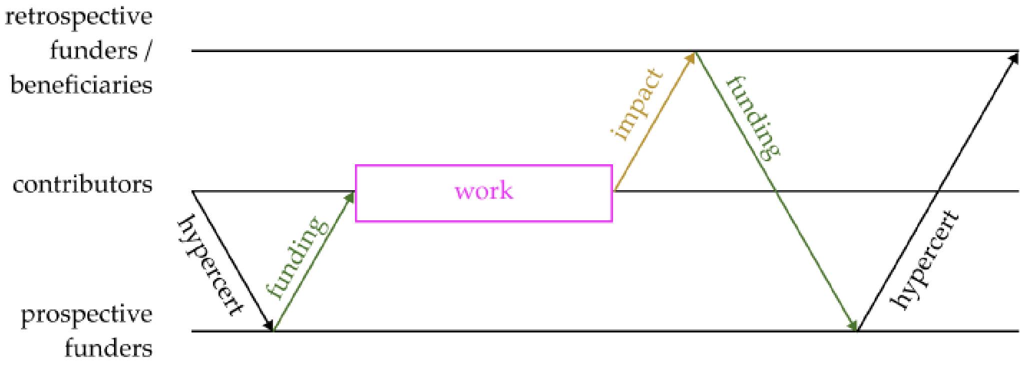

Figure 9: Transferable hypercerts facilitate retrospective funding, adapted from Dalrymple (2022)

Increasing rewards

Retrospective funding allows us to increase rewards as more impact is created because impact is easier to observe, measure and prove retrospectively. Increasing rewards – as shown in figure 10 – incentivizes contributors to put in their highest effort to produce impact and enables contributors to be rewarded for their talent. Moreover, prospective funders are incentivized to select, fund and support the projects with the highest expected impact, if they also receive retrospective rewards.

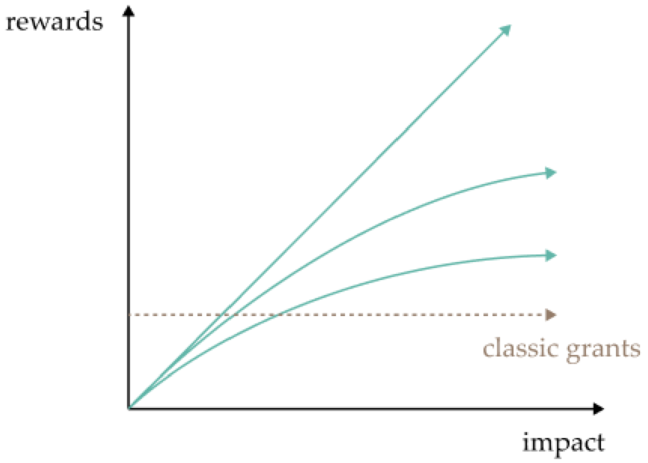

Figure 10: Rewards are increasing in the impact created

Note that retrospective funding should not be used in cases where a significant negative impact is possible since a nongovernmental, permissionless framework can not impose retrospective penalties for negative externalities. See Ofer & Cotton-Barratt (2022) for a discussion of this limitation of retrospective funding.

In some cases we do not expect the retrospective evaluation to be any different than the prospective evaluation, i.e. there is no uncertainty resolved over time as the impact of an activity is already "known" prospectively. In these cases retrospective funding would only complicate the funding mechanism and funding via grants or milestone bounties would be preferable. Retrospective funding is preferable only if uncertainty is resolved over time.

Impact evaluations

The relevance of impact evaluations will depend on how much their signals influence the funding decisions of retrospective funders (see figure 1 in chapter 2). This is a critical difference to many impact reports today: If a project was funded by a grant, the funders as well as the project want to receive a positive evaluation. If, however, the funding decisions of the retrospective funders are outstanding, they are interested in truthful signals about the impact. Hence, funders value improvements in evaluation methodologies and can fund independent evaluators. Evaluators in turn would build up a reputation for their evaluation methodologies and improve the strength of their signals to retrospective funders.

Impact evaluators can take on a range of forms ranging forms, such as

- Voting by relevant communities or beneficiaries
- Expert panels
- Professional evaluators similar to financial rating agencies
- Automatic monitoring and data collection by sensors and oracles

The most useful form or combinations thereof will depend on the specific requirements of the impact area. For a generalized framework on impact evaluators see Protocol Labs (2023).

While retrospective funding makes impact evaluations financially relevant for funders and contributors, hypercerts enable to pre-commit funding for those evaluations: As impact claims are never forgotten, any actor can at any time commit funding to a future evaluation of these claims.

7. Related work

The thinking around hypercerts are connected to previous ideas on impact certificates and retrospective funding (Christiano 2014, Christiano & Grace 2015, Optimism & Buterin 2021, Cotton-Barratt 2021, Drescher 2022). Extending this and implementing hypercerts as a new primitive for impact funding and to enable an open evaluation system is one further step towards more effective and efficient IFSs.

We are looking forward to many experiments and implementations that create new funding and evaluation mechanisms that use hypercerts and that have the potential to change the incentive layers resulting in more impactful projects, including high-upside/high-uncertainty projects. Based on these we will collaboratively develop hypercerts further to fulfill the promise of a new primitive for IFSs.

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